

TWO NEW KATYDIDS OF THE GENUS *MELANONOTUS*
FROM COSTA RICA WITH COMMENTS ON THEIR LIFE
HISTORY STRATEGIES (TETTIGONIIDAE:
PSEUDOPHYLLINAE)¹

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ABSTRACT: Two new katydids are described from Costa Rica extending the known range of *Melanonotus* northward. The contrast in life history and morphology between primary forest katydids and secondary growth or temperate species is discussed. The absence of regular nightly stridulation and morphological differences such as the extremely long antennae of the two *Melanonotus* species and other primary forest epiphyllid katydids are suggested as adaptations against bat predation.

DESCRIPTORS: Tettigoniidae; Pseudophyllinae; *Melanonotus*; Costa Rica; Bat predation; Behavior.

This paper is written to provide names for two relatively common katydids of the tropical rainforests of Costa Rica and to propose a hypothesis to explain the lack of continuous stridulatory activity by tettigoniids in the Costa Rican tropical rain forest.

The two tettigoniid species come from very different wet forest situations. One is from Finca La Selva, an Atlantic lowland research station operated by the Organization for Tropical Studies. The other is a montane forest reserve operated by the Tropical Science Center. Both species of *Melanonotus* extend northward the range of this primarily northwestern South American genus.

Melanonotus was described by Beier (1960) in his systematic review of the Pseudophyllinae, part II. The genus is a member of the Cocconotini and presently includes thirteen species (including the two described here) from northwest South America and Central America. *Melanonotus* species are characterized by their robust, bulky appearance, short tegmina which never extend beyond the apex of the abdomen, the relatively smooth, nonpunctate face, small blunt tooth on the scape of antenna, wrinkled or granulate pronotum, and the short styli of the male subgenital plate. All but the Central American species have the face and pronotum strikingly marked with black.

Melanonotus species are epiphyllid, venturing forth at dusk to forage, exposed, on leaf surfaces. The two species described here are clumsy, sluggish

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katydids which seem restricted to understory vegetation. Both are incapable of flight but one (*M. tico*) has the second pair of wings fully developed and they could possibly be used in gliding.

The author has been impressed by the absence of stridulatory activity by these and other katydids of the primary growth rain forests in Costa Rica. At La Selva, for instance, an investigator can readily locate a half dozen species of adult male katydids in the understory and not find a single singing individual. Contrastingly, outside the forest, in secondary growth, there is continuous stridulation by nearly all individuals of all species.

In an attempt to try and isolate the answer for the peculiar behavior of forest katydids, I have looked for qualities of the life histories which primary growth forest katydids share. The most obvious similarity is that all species are epiphyllic. They seem to move about quite freely at night, fully exposed. In addition, many species are flightless and those that are fully winged make little attempt to fly when disturbed. Instead, they either drop quietly to the ground or crouch close to the leaf holding tightly by means of the sharp tarsal claws which become embedded in the leaf tissue. Under such conditions, the katydids are quite difficult to remove. The single morphological characteristic possessed by all species is the exceptionally long antennae (see figs.). Katydids of temperate regions seldom have the antennae three times as long as the body length but primary growth tropical forest species frequently have these appendages five to eight times the length of the body. Interestingly, the katydids which occupy secondary growth adjacent to the primary growth forest all lack the lengthened antennae. They are quite similar to their temperate counterparts in this respect.

The most obvious explanation for the development of the antennae among forest katydid species seems to be an adaptation against predation. And because of the contrasting nature of characteristics of primary forest katydids and those of secondary growth, one would have to look for a predator distinctive to the primary forest. A nocturnal predator would be most likely since the katydids remain secluded and inactive during the day in retreats such as hollow stems, under bark, or in unfurling *Heliconia* leaves. Most reptiles would then be eliminated from consideration and the katydids themselves are much too large for epiphyllic amphibians. The most obvious predator would seem to be bats.

D.E. Wilson (personal communication) has stated that the largest proportion of leaf-gleaning insectivorous bats are found in primary forest situations. Second growth species are almost all frugivores or omnivores and do not specialize on gleaning food from leaf surfaces. Wilson and Fleming (personal communications) further state that there are potentially ten species

of bats which could be considered as possible leaf-gleaners in the primary forest at La Selva. These are phyllostomatine bats of the genera *Micronycteris*, *Trachops*, *Lonchorina*, *Tonatia*, *Mimon*. *Trachops cirrhosus* is known to feed on sleeping lizards and Wilson also states that he has seen them feed on katydids in captivity. Wilson (1971) studied the habits of *Micronycteris hirsuta* in primary forest in Panama and discovered that katydids make up 25% of its diet. He suggested that the bats take their prey from leaf surfaces. Fenton (1974) commented extensively on the feeding ecology of insectivorous bats.

The reduced stridulatory activity would seem to be an adaptation against a predator which would obtain its food source by sound detection. A continuously singing, exposed, insect would be an easy target for a foraging bat. However, as Wilson suggests, animals which possess a hearing system acute enough to use echolocation might well hunt by picking up sounds originating from the prey themselves. Stridulatory sounds would aid the predator but other sounds, perhaps those made by the chewing katydid could also be detected by the bat. The elongate antennae of forest katydids would seem to serve in the detection of wind currents as produced by bats and the crouching "stick tight" behavior would make them difficult to remove from the substrate, especially if the bat were to try and do so on the wing.

The author has not observed bats take katydids from leaves but has circumstantial evidence from collections of bats made near San Vito, Costa Rica (montane primary forest). Bats were mist netted during March 1973 which had large pseudophylline katydids in their mouths. Several species were captured by the bats and could be recognized as typical of forest habitats. In addition, the katydids were short-winged species incapable of flight. The most reasonable explanation is that they were picked up from their perches by the marauding bats.

Melanonotus tico Rentz, new species

(Figs. 4-7, 11, 16)

HOLOTYPE MALE. Costa Rica, Heredia Province, Finca La Selva, on Rio Puerto Viejo, 24 February 1969. D. C. Rentz collector. Holotype and allotype deposited in the Academy of Natural Sciences of Philadelphia.

Head large, poorly seated in pronotum, longer than broad, without punctuation and facial carinae; frons, when viewed laterally, swollen, produced in intra-ocular region. Fastigium of vertex sloped, deeply grooved, apex acute, not attaining scrobes of antennae; scape of antenna robust, with a broadly raised, tubercle (fig. 11) on distal portion of internal margin; flagellum extremely long, fully seven times the length of body.

Pronotum dorsally and laterally granulate, with two indistinct transverse sulci, one at distal limit of prozona, the other at same of mesozona; anterior margin broadly obtuse, posterior margin truncate, rimate and slightly raised; ventral margin of lateral lobe truncate, obtusely produced in anterior third, posterolateral angle distinctly obtuse. Prosternum bearing a pair of widely spaced, elongate spines.

Appendages: fore femur strongly compressed, concave on internal (anterior) margin, bearing three evenly spaced rather elongate teeth in distal fifth, both genicular lobes unarmed; fore tibia straight, broadened distad of auditory foramen, dorsal surface unarmed, ventral surface bearing seven spines on anterior margin including apical spine, posterior margin bearing six and seven spines, on apical in position; median femur compressed with three teeth on posterior margin of ventral surface in distal quarter, anterior genicular lobe armed with a relatively elongate tooth; median tibia thickened in proximal third, unarmed dorsally, ventral surface with seven spines on both margins, distal spines apical in position; hind femur short, glabrous, slightly surpassing apex of abdomen, external margin armed on ventral surface with five large teeth in distal half; hind tibia armed on ventral surface with seven internal and external spines, apex with four short spurs; dorsal surface armed on external margin with seven spines, no apical spine or spur, internal margin bearing ten spines and one subapical spine, internal genicular lobe armed.

Tegmina abbreviate, lanceolate, scarcely attaining apex of fifth tergite; stridulatory region with distinct speculum; costal and subcostal vein very heavy, other venation reduced except for dense reticulate pattern of secondary veins; wings well developed.

Abdomen dorsally without median carina, tenth tergite (fig. 4) basically unmodified, median portion weakly concave, supraanal plate broad, unmodified; cercus stout, cylindrical, apex narrowed with a small internal apical tooth; subgenital plate (fig. 5) short, V-shaped incision occupying about distal third or fourth of plate, styles very elongate about two thirds length of plate.

Coloration: overall ground color uniform yellow brown, no black areas distinctive of other members of the genus. External visible portion of mandible dark brown. Eye grey, fastigium of vertex and antennal scrobes dark brown, scape and pedicel dark brown; flagellum much darker brown, distal portions of first and fifth flagellar segments black; all pleurites and sternites straw brown, without black; pronotum uniformly yellow brown as body but distal one sixth of disk slightly darker; tegmina dark brown, costa and subcosta yellowish brown, similar to *Ischnomela gracilis* and *I. pulchripennis* which are present at the same locality; abdomen uniform yellow brown; legs yellow brown as ground color, without any darker areas; femoral teeth yellow, only apex dark brown, tibial spines dark brown, weakly lighter at base; abdomen somewhat darker brown than rest of body; cerci, supra-anal plate light brown, cercal tooth black.

PLATE I

Figure 1, top. Pseudophylline katydid, *Scopiorinus* sp., an inhabitant of primary forest undergrowth, illustrating extraordinarily long antennae. The insect itself is approximately 15 mm in length.

Figure 2, bottom. Allotype, *Melanonotus tico* Rentz, new species on leaf surface at night.



ALLOTYPE FEMALE. Same data as holotype except collected 17-19-March-1973. Differs from holotype in following: size much larger; supra-anal plate triangulate, unmodified; cercus slender, apex narrowed, distinctly directed inward; ovipositor short, broad basally, rather straight, weakly serrate on dorsal margin only in median portion; subgenital plate triangulate, apex acute, feebly produced; tegmina longer, attaining seventh tergite. Armature of legs as follows: hind tibia armed ventrally on external margin with eight spines on both margins not including apical spurs. Coloration very similar to male with following exceptions: flagellum of antenna black; ovipositor basically straw brown, this extending medially to apex, dorsal and ventral portions of distal two thirds dark brown.

Derivation of name. — This species is named for the friendly people of Costa Rica.

Records. — Costa Rica: Heredia Province, Finca La Selva, on Rio Puerto Viejo, 18, 19-II-1966 (H. R. Roberts, 1♂ 1♀, in hollow palm stem); 23-II-1969 (D. C. Rentz, 1♂); 17-19-III-1973 (D. C. Rentz, 1♂, 2♀♀, on loop trail and in arboretum, allotype); 13-16-VII-1973 (D. C. Rentz, K. R. Brodey, 3♀♀ arboretum II); 14-16-I-1975 (D. C. Rentz, 2♀♀, loop trail. Limon Province, Pandora Farm, Estrella Valley, 100 Ft. elevation, 13-IX-1923 (J. A. G. Rehn, 1♀). Paratypes deposited in Smithsonian Institution, Vienna Museum, and Academy of Natural Sciences of Philadelphia.

Karyotype. — $2N♂ = 33$. All chromosomes telocentric. The X is by far the largest chromosome. There are two large class autosomes with the remaining 14 autosomes forming a gradually declining series with reference to size.

Geographic distribution. — *M. tico* is known from the Atlantic lowlands of eastern Costa Rica.

Variation. — The paratypic series reflects very little variation. The female from Estrella Valley bears shorter tegmina, attaining only the apex of the third tergite, the fore femur of the right side bears only two teeth, the other side three. In other respects, the series is quite uniform.

Discussion. — *M. tico* lives in the understory vegetation of primary growth wet forests in the Atlantic drainage of Costa Rica. Frankie et al (1974) provided a description of the site and listed references to others who have done so. Briefly, Finca La Selva is an undisturbed Lowland Rain forest located at latitude $10^{\circ} 23'N$ at around 140 meters elevation. Considerable rainfall occurs during each month. Mean annual precipitation quoted by them was within a range of 2900 to 5600 mm. There is a single lengthy dry season from late January to April; a second less extensive dry period usually lasts from November through January.

The vegetation of La Selva is considered Tropical Rain Forest. In the Holdridge (1967) scheme, La Selva is geographically and bioclimatically overlapping the boundary between Tropical Wet Forest and Premontane Wet Forest life zones. Frankie et al (1974) listed six community types present at La Selva. From the observations of *M. tico* I find that this katydid occurs in the Wet Forest, Swamp Forest and Riparian Forest communities.

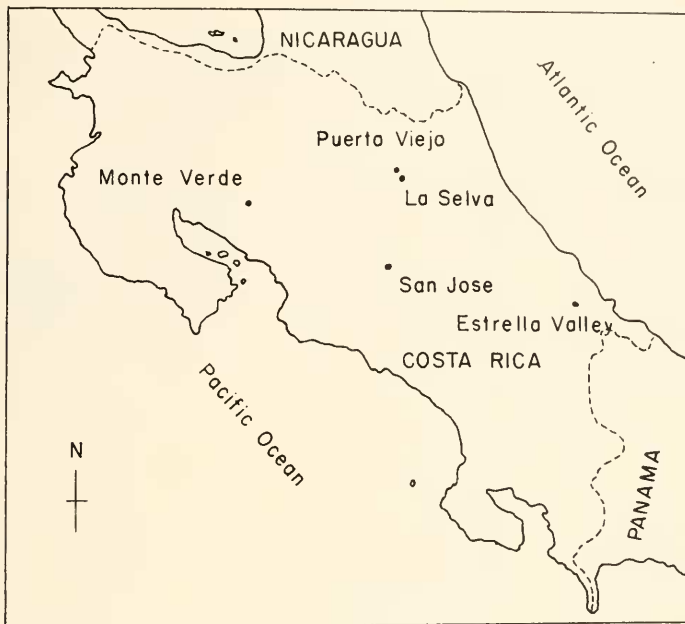


PLATE II

Figure 3. *Melanonotus* localities in Costa Rica.*Melanonotus powellorum* Rentz, new species

(Figs. 8-10, 12-15, 17)

HOLOTYPE MALE. Costa Rica, Puntarenas Province, Tilarán Mountains, Monte Verde, 1580 meters elevation, Monte Verde Cloud Forest Preserve, near Powell house, 23 March 1974. D. C. Rentz collector. Holotype and allotype deposited in Academy of Natural Sciences of Philadelphia.

Head very large, protruding from pronotum, very broad, without facial punctation or carinae; frons, when viewed laterally, highly swollen, in intra-ocular region, concave dorsad of clypeus; fastigium of vertex small, deeply furrowed, apex acute, attaining only dorsal two thirds of antennal scrobes; scape of antenna robust, with a low, broad tubercle positioned subapically at internal margin; pedicel half the length of scape, ventral edge of internal margin produced; flagellum of antenna very long, four times length of body.

Pronotum with lateral lobes poorly produced, dorsally and laterally weakly rugulose; dorsal surface with two distinct transverse sulci, the anterior sulcus shallow, poorly indicated, posterior sulcus broad and deep, delimiting distal third of disk; anterior margin convex, posterior margin truncate, weakly rimate; ventral margins of lateral lobe weakly undulant, posterolateral angle obtuse. Prosternum armed with a pair of close-set elongate spines.

Appendages: fore femur strongly compressed, concave on anterior margin, bearing two evenly spaced, rather elongate teeth in distal fifth, the apical tooth much the longer, both genicular lobes unarmed; fore tibia straight, hardly broadened distad of auditory foramen; dorsal surface unarmed, ventral surface with seven very small spines on internal margin, external margin with six small spines, the distal spine apical in position; median femur compressed with two and three teeth on outer margin of ventral surface positioned in distal one quarter, only internal genicular lobe armed; median tibia thickened in proximal one third, unarmed dorsally, ventral surface bearing seven spines on both margins, distal three spines apical in position; hind femur short, not attaining apex of tenth tergite, external margin of ventral surface bearing four and five large teeth in distal half, hind tibia armed on ventral surface with eight and nine spines, internal margin with five spines, apex bearing four short spurs; dorsal surface armed on external margin with five and six spines, no apical spur, internal margin with ten and eleven spines, internal genicular lobe armed.

Tegmina abbreviate, apex obtuse, shorter than dorsal length of pronotum, attaining only the basal quarter of first abdominal tergite, stridulatory region with a small but distinct speculum; costal and subcostal vein heavy, other venation reduced except for reticulate pattern of secondary veins; wings reduced.

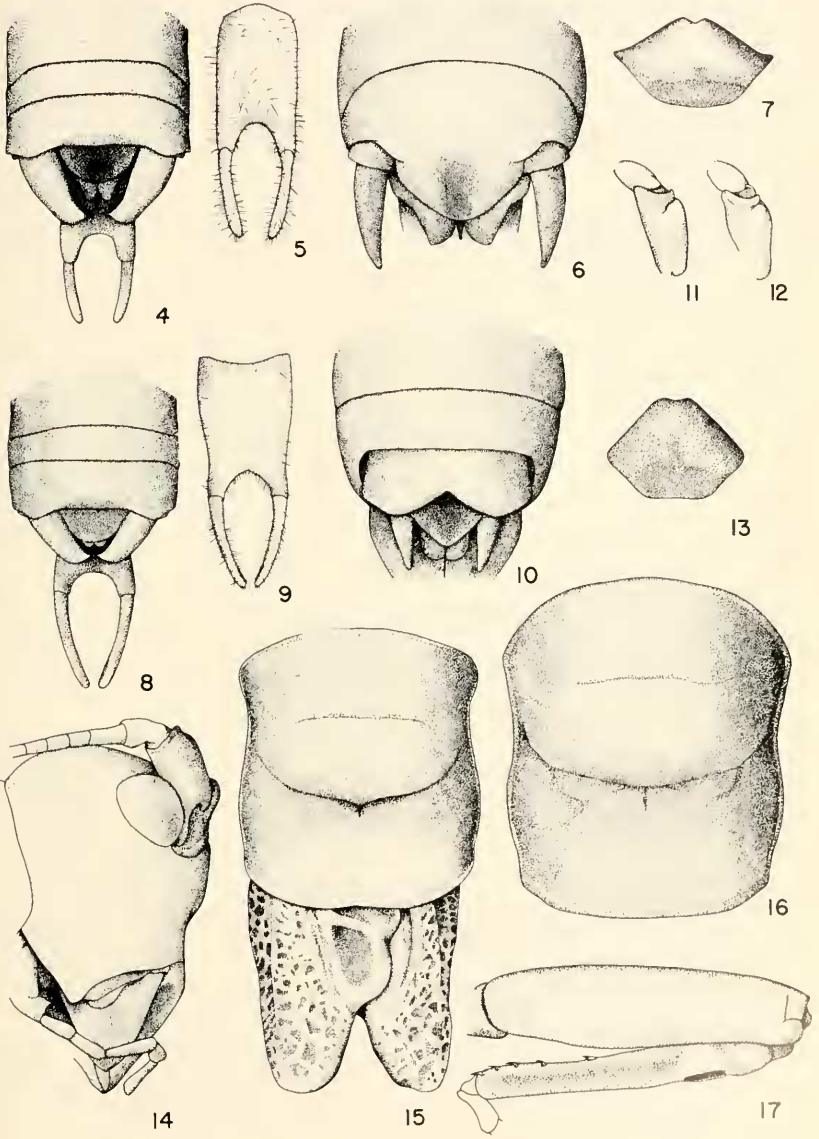
Abdomen dorsally without carina, tenth tergite (fig. 8) simple, with a broad, shallow notch, supra-anal plate broadly triangulate; cercus elongate, cylindrical with a small internal apical tooth; subgenital plate (fig. 9) short, V-shaped incision occupying about distal fifth of plate, styles elongate, gracefully incurved.

Coloration: overall ground color uniform yellow brown, distal margins of abdominal tergites somewhat darker; external visible portion of mandible red brown; eye grey, fastigium of vertex dark brown, scape and pedicel dark reddish brown, flagellum black; all pleurites and sternites straw brown; pronotum darker brown in apical portion of disk; tegmina dark brown, reticulate veins straw or yellow brown; legs yellow brown, without any markings, femoral and tibial teeth and spines yellow, only apex dark brown; cercus and supra-anal plate grey brown, subgenital plate yellow brown, apex and styles blackish.

PLATE III

Figures 4-7, 11, 16, *Melanonotus tico*. Fig. 4, dorsal view abdomen, holotype male; fig. 5, same ventral view subgenital plate; fig. 6, dorsal view abdomen, paratopotype female; fig. 7, same, subgenital plate; fig. 11, anterolateral view antenna, holotype male; fig. 16, dorsal view pronotum, holotype male.

Figures 8-10, 12-15, 17, *M. powellorum*. Fig. 8, holotype male, dorsal view abdomen; fig. 9, same ventral view subgenital plate; fig. 10, allotype female, dorsal view abdomen; fig. 12, holotype male anterolateral view basal antennal segments; fig. 13, allotype female, subgenital plate; fig. 14, lateral view head, holotype male and fig. 15, dorsal view pronotum and tegmina; fig. 17, holotype male, external view right foreleg.



ALLOTYPE FEMALE. Same data as holotype. Differs from holotype in following: size much larger; supra-anal plate triangulate, unmodified, cercus robust, straight, apex not directed inward; ovipositor short, broadest in basal third, dorsal margin very weakly serrate; subgenital plate broader than long, apex obtuse; tegmina short, ovate, barely attaining apex of first abdominal tergite, apex broadly rounded. Coloration very similar to male except ovipositor basically dark brown with a lighter straw brown medial longitudinal stripe.

Derivation of name. — This species is named for Mr. and Mrs. George Powell who together with L.R. Holdridge have had the foresight to single-handedly seek to preserve the unique habitat which is the type locality for this species.

Records. — Costa Rica: Puntarenas Province, Tilarán Mts., Monte Verde, Powell Property, 23-III-1974 (D.C. Rentz, 3♂♂, 3♀♀, holotype, allotype); 22-VII-1973 (D.C. Rentz, K.R. Brodey, 1♀). Paratypes deposited in the Smithsonian Institution and Vienna Museum.

Geographic distribution. — *M. powellorum* is known only from the type locality.

Variation. — The paratopotypic series is quite uniform in all respects. The two teneral females are somewhat lighter in color.

Discussion. — *M. powellorum* is relatively common at night in the understory vegetation near the Powell residence in the Forest Reserve. The exact location of the type locality is in the Cordillera de Tilarán, a range distinct for its lack of large peaks. Climatically the region has two seasons, a Pacific dominated rainy season with intense daily thunderstorms, and an Atlantic dominated dry-windy season. The strong winds of the dry season produce a climate that is extremely cool and wet relative to its middle elevation altitudinal position and a pronounced moisture and temperature gradient from windward to leeward over very short distances. This diversity of local climate and richly volcanic soils supports a very large number of plant and animal species, Powell (mineo undated).

The Monte Verde Reserve lies within the Lower Montane altitudinal belt, Holdridge (1967). The sharp dry season moisture gradient creates a division into Lower Montane Rain, Wet and Moist Life Zones with decreasing moisture accumulation. The Lower Montane and Wet Life Zones form the major part of this area. The katydids described here seem to prefer the Lower Montane Wet Forest of the Pacific slope, a taller community of trees dominated by large oaks (*Quercus*) and a number of Lauraceae including Yas (*Perséa schiedaana*) and the wild avocado (*Persea americana*). Also present are large stranglar figs (*Ficus*). The understory where *M. powellorum* occurs consists of a thick dense aggregation of shrubs and small trees in the families Rubiaceae, Acanthaceae, Solanaceae, Chloranthaceae, Piperaceae, and Melostomaceae.

	Length body	Length pronotum	Length tegmina	Length fore femur	Length median femur	Length hind femur	Length ovipositor	Width ovipositor
<i>powellorum</i>								
Males								
Holotype	29.8	6.4	4.5	7.9	7.5	13.5		
paratype	28.5	6.4	4.4	7.5	7.4	14.0		
paratype	29.7	6.3	4.3	7.3	7.3	13.6		
Females								
Allotype	36.0	7.5	4.8	10.2	10.2	18.7	17.0	3.7
paratype	28.5	6.3	5.0	8.7	8.4	15.8	14.5	3.3
paratype	33.5	7.1	5.2	9.2	9.5	17.5	16.0	3.6
paratype	33.5	6.9	5.0	9.0	9.0	17.5	16.0	3.5
<i>tico</i>								
Males								
Holotype	32.8	8.2	14.0	10.0	9.1	17.5		
paratype	32.5	7.8	13.9	9.8	9.2	18.0		
paratype	37.0	8.2	15.0	10.0	9.6	X		
Females								
Allotype	38.6	8.5	19.4	11.5	11.5	22.0	19.0	4.0
paratype	39.5	8.6	19.0	11.2	11.0	22.2	18.0	3.8
paratype	41.0	8.3	20.2	11.5	11.2	22.2	18.0	4.0
paratype	36.5	8.5	18.0	11.5	11.0	22.2	19.0	4.0
paratype	40.0	8.4	18.6	11.5	10.7	22.0	18.2	3.7
paratype	40.0	8.7	19.0	11.5	11.0	22.5	19.0	4.0
paratype	42.1	8.4	20.4	11.5	11.2	22.0	19.0	3.7
Estrella Vy								
	41.0	8.4	15.0	11.0	10.6	21.5	19.0	3.9

Table 1. Measurements of adults of *Melanonotus tico* and *M. powellorum*.

M. powellorum extends at least down the Pacific slope into the Lower Montane Moist or Humid Forest (near Pensión) which is a more open type, temperate in climate, and harbors a considerable number of deciduous tree species which let in more light during the dry season.

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LITERATURE CITED

- Beier, M. 1960. Revisionen der Pseudophyllinen, Part II. Das Tierreich, 74: 1-396.
- Frankie, G.W., H.G. Baker, and P.A. Opler. 1974. Comparative phenological studies of trees in tropical wet and dry forests in the lowlands of Costa Rica. *Journal of Ecology*, 62: 881-919.
- Holdridge, L.R. 1967. Life zone ecology, revised edition. Tropical Science Center, San Jose, Costa Rica. 206 pages.
- Powell, G.R. undated. The Monte Verde cloud forest reserve. Mimeo.
- Wilson, D.E. 1971. Food habits of *Micronycteris hirsuta*. (Chiroptera: Phyllostomidae). *Mammalia*, 35(1): 107-110.